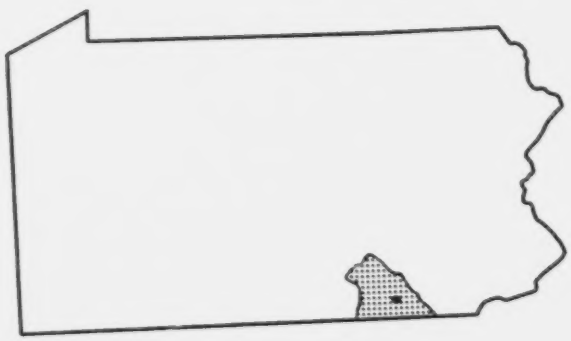
FLOOD INSURANCE STUDY

25

BOROUGH OF YOE, PENNSYLVANIA
YORK COUNTY



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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY

BOROUGH OF YOE, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Borough of Yoe, York County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the Borough of Yoe to the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Gannett, Fleming, Corddry, and Carpenter, Inc., for the FEMA, under Contract No. H-4820. This study was completed in May 1981. All field surveys and aerial mapping were performed by or under the direction of Quinn and Associates of Horsham, Pennsylvania.

1.3 Coordination

Upon the initiation of the study, a legal notice was placed in the York Dispatch one day a week for three consecutive weeks, beginning August 28, 1979, to notify all interested persons to submit any relevant facts and technical data concerning local flood hazards. Streams requiring detailed study were identified at a meeting attended by representatives of Gannett Fleming Corddry and Carpenter, Inc. (the study contractor), the FEMA and the Borough of Yoe on June 9, 1978. During the study contact was made with the Susquehanna River Basin Commission (SRBC), the U. S. Geological Survey (USGS), and the FEMA.

On August 19, 1981 , the results of the study were reviewed at the final meeting attended by representatives of the study contractor, FEMA, and community officials. The study was acceptable to the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Borough of Yoe, York County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The limits of detailed study in the Borough of Yoe were determined by the FEMA, with community and study contractor consultation at the meeting in June 1978.

Mill Creek was studied by detailed methods from the downstream corporate limits to the upstream corporate limit of the Borough of Yoe.

The area studied by detailed methods was selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through May, 1986.

2.2 Community Description

The Borough of Yoe is located in the east central portion of York County in south central Pennsylvania. The total land area contained within the borough limits is 0.21 square mile. It is situated approximately 5 miles southeast of York, Pennsylvania, and 1.5 miles west of Red Lion, Pennsylvania. The borough is bounded to the north, east and west by York Township with Dallastown forming a portion of the southern borough boundary. According to U. S. Census Bureau figures, the population has increased from 731 in 1960 to 790 in 1970, which represents an increase of 8.1 percent (Reference 1).

Mill Creek flows northwest through the borough and is a tributary to Codorus Creek, with its confluence just north of York between State Route 250 and Interstate Route 83. It has a length of 9.4 miles extending from the headwaters near the western boundary of Red Lion to its confluence with Codorus Creek. It falls about 480 feet through its length and has a drainage area of 18.5 square miles at its mouth. Approximately eighty-five percent of the borough has been developed, with the remainder of land being vacant or wooded. Within the flood plains studied, development consists of single family residences and a few private businesses. State Routes 24 and 74 are the primary highways serving the area.

The Borough of Yoe is located in the Piedmont Province of Pennsylvania which is characterized by gently rolling hills and an undulating terrain. The range in local elevation varies from 765 feet in the northwestern portion of the borough to over 840 feet in

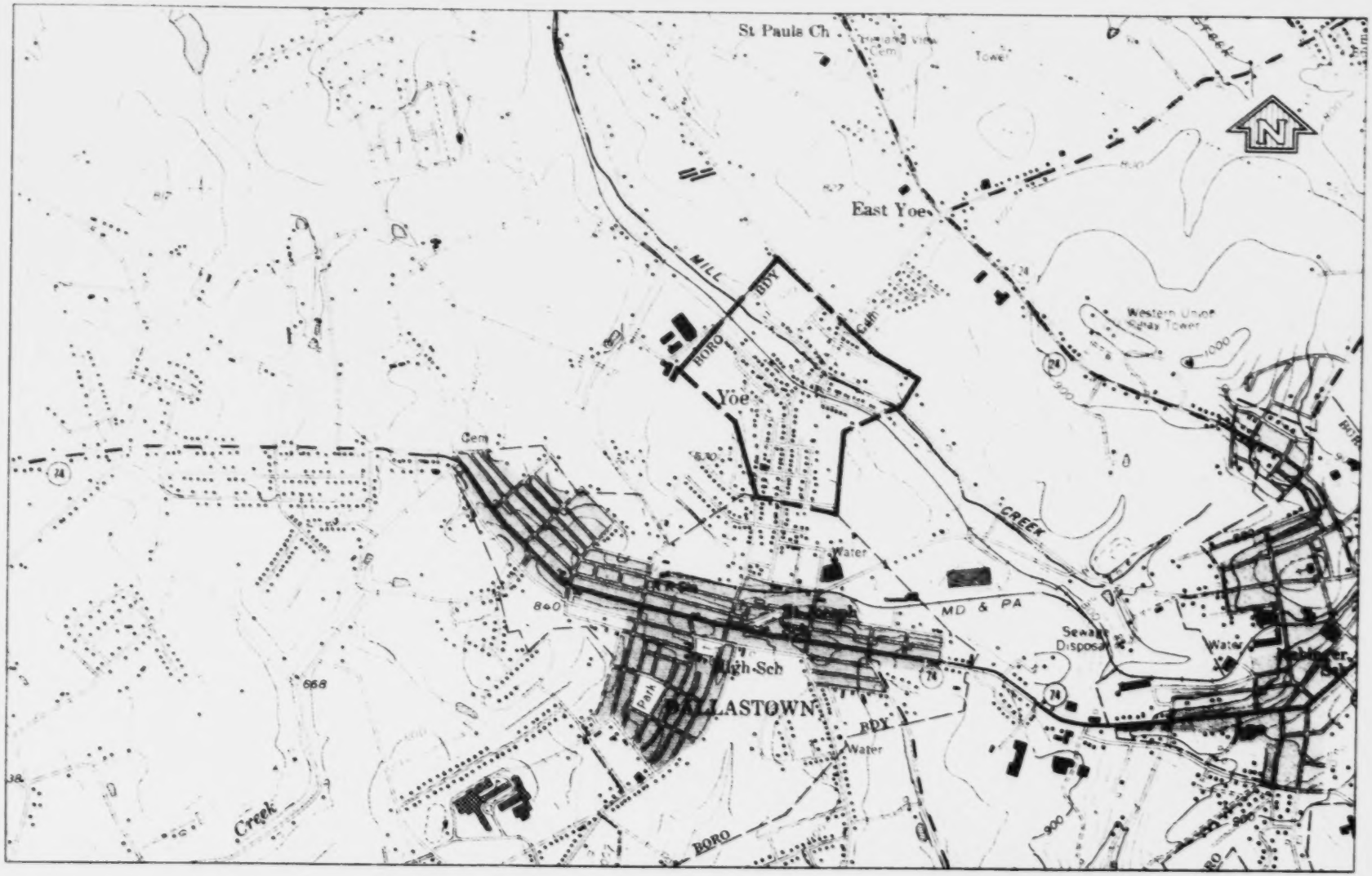

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF YOE, PA

(YORK CO.)

APPROXIMATE SCALE

2,000' 0 2,000' 4,000' 6,000'

VICINITY MAP

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the southern section of the borough. The land form is a result of geologic activity in which huge layers of rock were folded upwards by tremendous amounts of internal pressure. Erosion from climatic elements have gradually worn down the sharper protrusions to form the rounded hills.

The climate in south central Pennsylvania is characteristically humid continental. Average summer and winter temperatures range from 66.9 degrees Fahrenheit (°F) to 38.7°F, respectively (Reference 2). Annual average precipitation of the region is 40.4 inches with an average recorded snowfall of 31.8 inches. The precipitation is fairly uniformly distributed throughout the year with the wettest months being July and August (Reference 3).

2.3 Principal Flood Problems

The past history of flooding in the Mill Creek watershed indicates that flooding may occur during any season of the year. The majority of major floods in south central Pennsylvania have occurred during late spring and early fall and are often the result of storms associated with tropical storms moving up the Atlantic coastline.

No high water elevations or flood damage estimates were available for Yoe, and borough officials reported that no overbank flooding has been experienced within the borough for the past ten years. High water was experienced on Mill Creek in Yoe Borough in June 1972 and again in September 1975, with the 1975 high water attaining the greatest depth. The June 1972 high water was a result of heavy rains associated with the passage of Tropical Storm Agnes. This storm produced the flood of record at many locations and devastated flood plains of the Susquehanna River Basin. The flooding experienced in September 1975 was associated with Tropical Storm Eloise which also produced widespread flooding throughout the Susquehanna River Basin. The high water in 1972 and 1975 was reported by local residents to have been just below the low chord of the culvert connecting Church Street and Main Street. As illustrated in Figure 2, the estimated 100-year flood is 1.8 feet above the top of the road at this location.

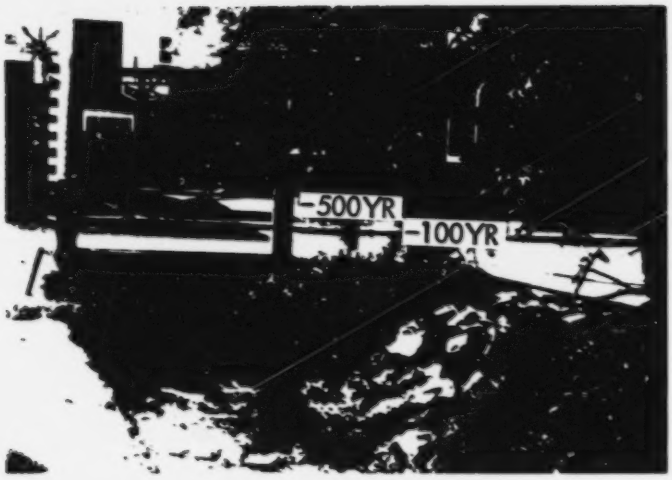

Figure 2. View of upstream face of culvert connecting Church Street and Main Street. The estimated 100-year and 500-year flood levels are indicated (photo date July 1979).

2.4 Flood Protection Measures

Currently there are no flood control dams upstream of the Borough of Yoe or other protection devices within the corporate limits of the Borough of Yoe. However, retaining walls have been installed at numerous locations along Mill Creek within the borough. These improvements tend to increase the flow capacity of Mill Creek through the borough and thereby minimize flood elevations. These effects were included in the hydraulic analysis which was performed as part of this study.

Non-structural measures of flood protection are being utilized to aid in the prevention of future flood damage. These are in the form of land use regulations adopted from the Code of Federal Regulations which control building within areas that have a high risk of flooding (Reference 4).

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence intervals), have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare

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flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50 year period is about 40 percent (four in 10), and for any 90 year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail in the community.

For the detailed study of Mill Creek the hydrologic analysis followed the procedures presented in a publication by the Soil Conservation Service (Reference 5 & 6). Peak flood flows were estimated based upon published rainfall frequency data (Reference 7) and watershed characteristics measured from existing maps.

A summary of the drainage area-peak discharge relationships for Mill Creek is presented in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
MILL CREEK					
Downstream Corporate Limit	1.47	342	615	755	1,150
Upstream Corporate Limit Near Front Street Bridge	0.97	215	389	496	800

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding source studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the flooding source.

Composite cross sections for the backwater analyses of Mill Creek were obtained from third order field surveys and photogrammetric compilations from aerial photographs. Underwater portions of the cross sections were field surveyed. All bridges and culverts were field measured to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2). Channel roughness factors (Manning's "n") used in the hydraulic computations, were based on field observations of the streams and flood plain areas using the procedures outlined in a publication by the Soil Conservation Service, National Engineering Handbook (Reference 8). Roughness values for the main channel of Mill Creek range from 0.040 to 0.055 with flood plain roughness values of 0.070 for all floods.

Water surface elevations of floods of the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater computer program (Reference 9). Flood profiles were drawn showing computed water surface elevations to an accuracy of ± 0.5 foot for floods of the selected recurrence intervals. Starting water surface elevations for Mill Creek were calculated using slope-area method. All elevations are referenced from the National Geodetic Vertical Datum of 1929, (NGVD) formerly referred to as Sea Level Datum of 1929; elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FEMA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the boundaries of the 100- and the 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were plotted using photogrammetric equipment, aerial photographs (Reference 10) and topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 11). In cases where the 100- and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations, and therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

4.2 Floodways

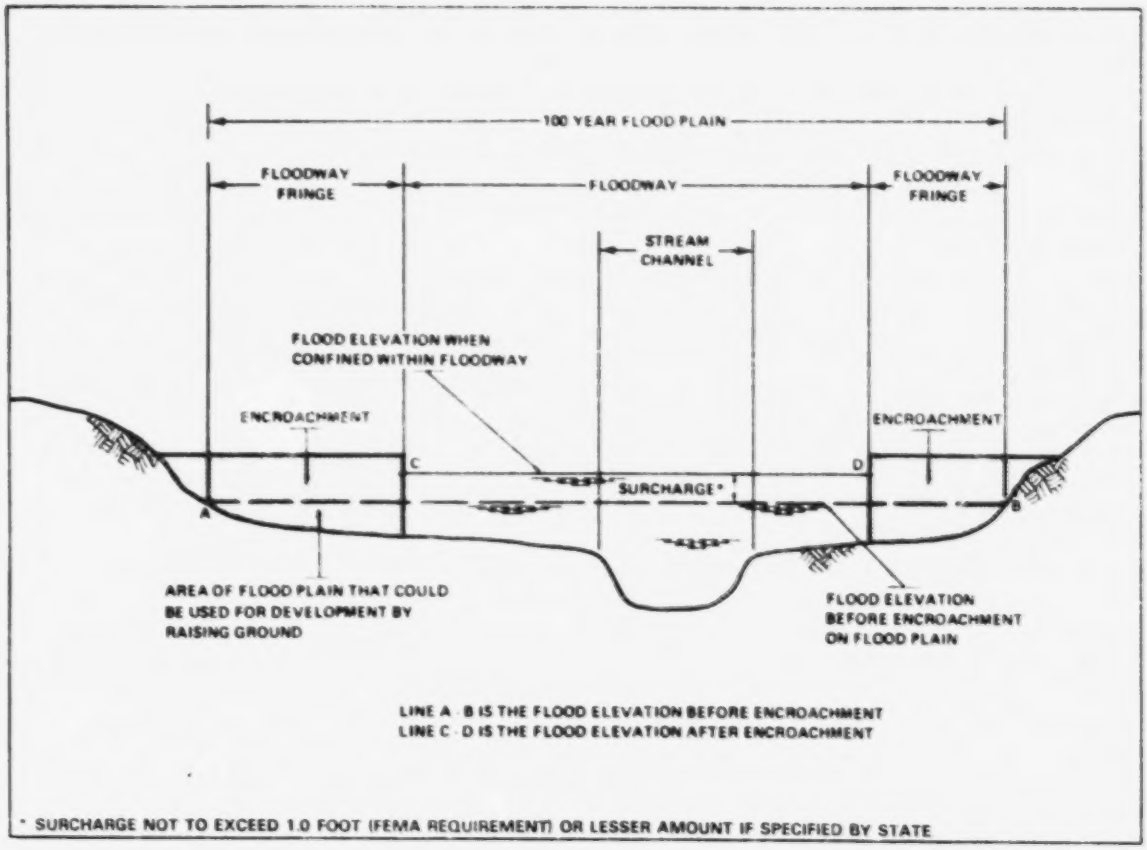
Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FEMA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this report is presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodway presented in this study was computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown. The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 3.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FEMA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for the flooding source affecting the Borough of Yoe.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
* SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC Figure 3

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot

The locations of the reaches determined for the flooding source of the Borough of Yoe are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Mill Creek								
A	695	40	152	5.0	677.8	677.8	678.5	0.7
B	1315	35	144	5.2	684.3	684.3	684.6	0.3
C	1460	33	106	7.1	685.2	685.2	685.4	0.2
D	1755	45	185	4.1	694.0	694.0	694.6	0.6

[1] Foot above corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF YOE, PA
(YORK CO.)

FLOODWAY DATA

MILL CREEK

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3]
		10% (10 YR)	2% (50 YR)	0.2% (500 YR)			
Mill Creek							
Reach 1	01	-1.2	-0.3	+0.6	010	A2	Varies
Reach 2	01	-2.1	-0.4	+1.0	020	A4	Varies

1 Flood Insurance Rate Map Panel
2 Weighted Average
3 Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOROUGH OF YOE, PA
(YORK CO.)

FLOOD INSURANCE ZONE DATA

MILL CREEK

5.2 Flood Hazard Factors (FHFs)

The Flood Hazard Factor is used to correlate flood information with insurance rate tables. Correlations between property damages from floods and their assigned FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between the water surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water surface elevations is greater than 10.0 feet, the accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Borough of Yoe was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A2, A4:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones assigned according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; or, areas subject to 100-year flooding from sources with drainage areas of less than one square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the Borough of Yoe.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Borough of yoe is, for insurance purposes, the principal result of the Flood Insruance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FEMA.

6.0 OTHER STUDIES

A Flood Hazard Boundary Map has been published for the continguous community of York Township (Reference 12). The results of this study have been coordinated with that map and no unreconcilable difference were found. No other studies were found to exist at the time of this report.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Curtis Building, Room 700, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

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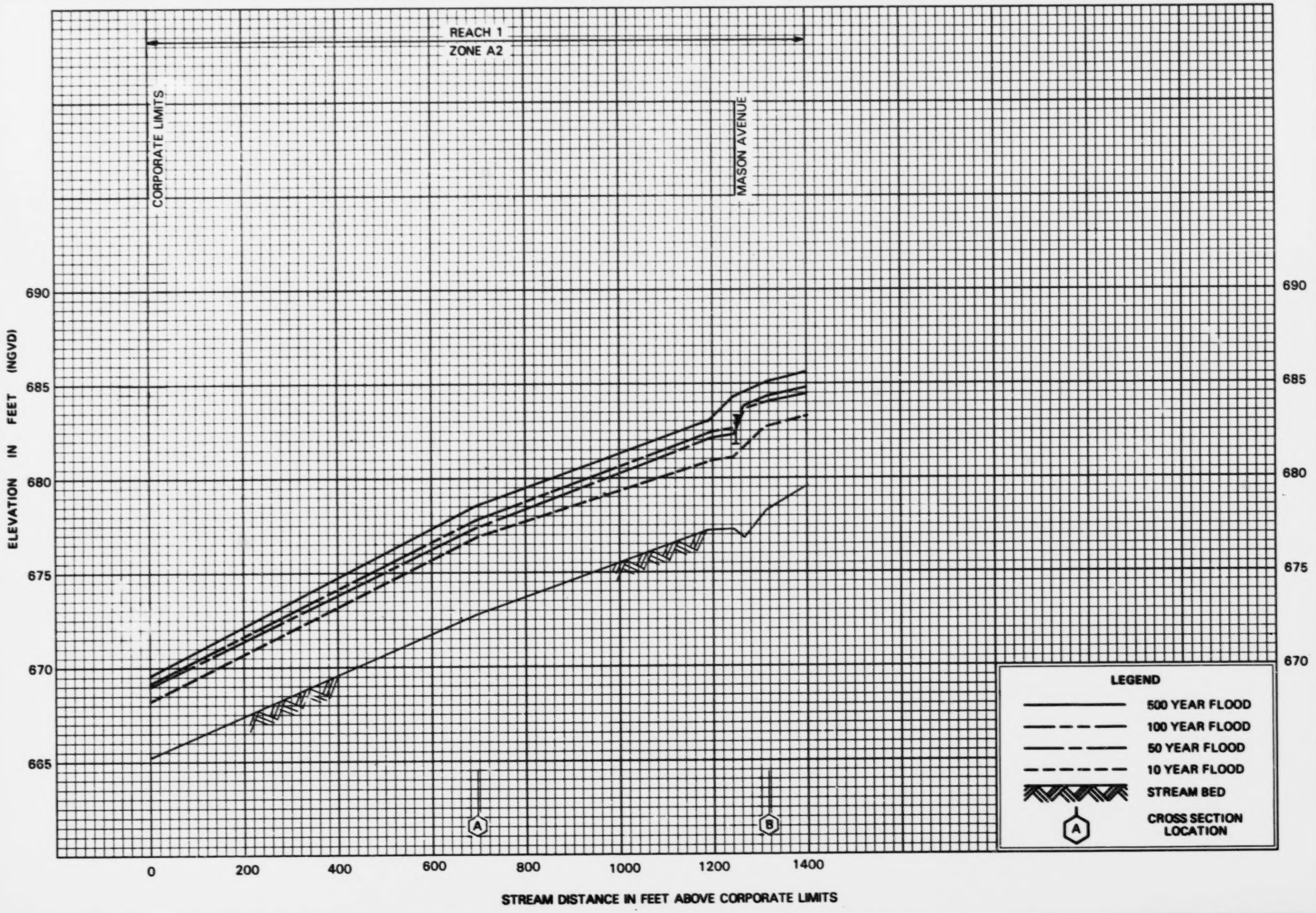

FLOOD PROFILES

MILL CREEK

federal emergency management agency

BOROUGH OF YOE, PA
(YORK CO.)

01P

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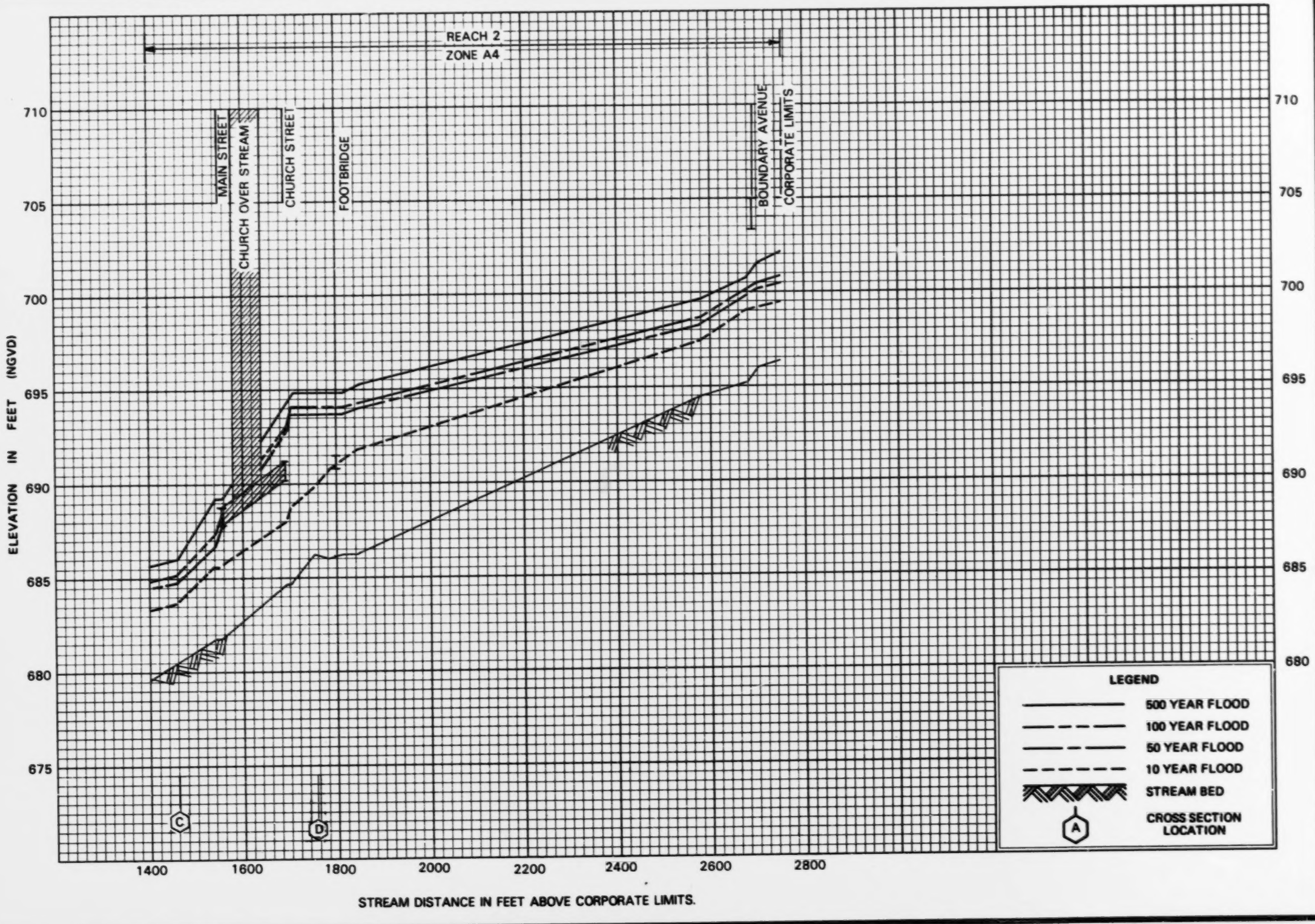

FLOOD PROFILES

MILL CREEK

federal emergency management agency

BOROUGH OF YOE, PA
(YORK CO.)

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